

ROOT AND CROWN ROT OF SILVER TREES*

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ABSTRACT

Greenhouse and field inoculations showed *Phytophthora cinnamomi* Rands to be the primary cause of root and crown rot, and subsequent dieback of the silver tree, *Leucadendron argenteum*. Other related hosts were also recorded, though certain *Protea* spp. appear to be tolerant to the disease.

UITTREKSEL

WORTEL EN KRAAGVERROTING BY SILWERBOME

Inokulasies in die glashuis en in natuurlike omgewings het getoon dat *Phytophthora cinnamomi* Rands primêr verantwoordelik is vir die wortel- en kraagverrotting en die gevolglike afsterwing van silwerbome, *Leucadendron argenteum*. Verwante gashere is ook aangetoon, alhoewel sekere *Protea* spp. verdraagsaamheid teen die siekte openbaar het.

INTRODUCTION

Silver trees (*Leucadendron argenteum*) are subject to a sudden dieback which is of common occurrence throughout the Western Cape. The first indication of disease is the wilting of the entire tree, but removal of the external bark of recently killed trees exposes a dark patch of rotted bark extending from the crown into the root (Fig. 1). This browning may also occur on some apparently healthy trees but is masked by the external bark.

Olivier (1951) and Wager (1970) ascribed dieback of silver trees to infection by the fungus *Botryosphaeria ribis* (Tode ex Fries) Gross & Dugg. However, Olivier's (1951) work was inconclusive in that inoculations of fully grown silver trees with *B. ribis* consistently failed to induce the disease.

The present investigation was carried out to establish the primary cause of dieback of silver trees.

MATERIAL AND METHODS

Isolation

Naturally infected plant material from Stellenbosch, Banhoek, Paarl, Somerset West and Kirstenbosch was plated out on corn meal agar after surface

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FIG. 1.
Rotted bark of the crown of a silver tree after removal of the external bark.



FIG. 3.
Lesion, causing shoot dieback of silver tree, from which *Botryosphaeria ribis* was isolated. External bark removed.



FIG. 2.
Lesions around cracks in the trunk of a silver tree from which *Botryosphaeria ribis* was isolated. External bark removed.



FIG. 4.
Wilting of a two-year-old silver tree after inoculation with *Phytophthora cinnamomi*. Control plant on the left.

disinfection for one minute with 2% sodium hypochlorite. Fungus isolates were subcultured and stored on potato-dextrose agar (PDA).

Inoculations

Inoculation was by means of the cork-borer method of Sewell and Wilson (1959). Agar discs were cut from well developed colonies of the test organism on PDA, while uninoculated PDA discs were used as control inoculum. Inoculation sites were sealed with vaseline. Except in the case of older trees, where inoculations were as high as four feet above soil surface, all inoculations were made near or at soil level.

Both potted plants in the greenhouse and plants in their natural environment at Kirstenbosch were inoculated. In greenhouse tests 27 silver trees, approximately two years old, were inoculated with *Phytophthora cinnamomi*, *B. ribis* and control inoculum. Three plants in each inoculation group were then held under each of the following temperature regimes: low (13–16C), high (24–31C) and fluctuating (10–25C). The experiment under the high temperature range was duplicated. Silver trees inoculated in their natural habitat were approximately two years old (four trees), six years old (four trees) and more than ten years old (one tree, four groups of inoculations). *Leucospermum cordifolium* (Salisb.) ex Knight Fourcade (one plant, two groups of inoculations) and *L. glabrum* Phillips (one plant, two groups of inoculations) were about five years old and were inoculated with *P. cinnamomi* only.

RESULTS

Isolations from naturally infected plants

Isolations from naturally infected silver trees yielded two fungi; one was constantly isolated from freshly rotted tissues of the crown. It was identified as a *Phytophthora* sp. and specifically as *P. cinnamomi* after comparison with an isolate from grapevine (Van der Merwe & Matthee, 1972) identified by the Commonwealth Mycological Institute. The other fungus was isolated from lesions around cracks (Fig. 2) and from shoots showing dieback (Fig. 3). It was also occasionally associated with *P. cinnamomi* in rotted crown tissues, especially in advanced stages of decay. It was a pycnidial fungus corresponding with the *Dothiorella* stage of *B. ribis*. Although no ascigerous stage developed, it was identified as the imperfect stage of *B. ribis* (personal communication, W.F.O. Marasas, Plant Protection Research Institute, Pretoria). The behaviour of the fungus in culture was also similar to that of *B. ribis* as described by Olivier (1951).

In addition to silver trees, *P. cinnamomi* was isolated from the following Proteaceae showing dieback symptoms: *Leucadendron tinctorum* Williams, *Leucospermum lineare* R. Br., *L. cordifolium* and *L. reflexum* Buck ex Meisn.



FIG. 5.
Lesion development on a young potted silver tree three months after inoculation with *Botryosphaeria ribis*. External bark removed.



FIG. 6.
Lesion development following inoculation of a young silver tree with *Phytophthora cinnamomi*. External bark removed.



FIG. 7.
Lesions on a full grown silver tree 10 days after inoculation with *Phytophthora cinnamomi*. Control inoculation in the centre. External bark removed.

Inoculations

Greenhouse inoculations

All plants inoculated with *P. cinnamomi* developed brown lesions similar to those observed in naturally-infected trees. Plants at low and fluctuating temperatures developed the brown discolouration only at the inoculation sites but none died within a period of three months after inoculation. In contrast, all plants held at high temperatures died within 10–12 days (Fig. 4).

Inoculations with *B. ribis* were also positive, though the browning was limited (Fig. 5) and contrasted markedly with the progressive browning (Fig. 6) caused by *P. cinnamomi*. None of the plants inoculated with *B. ribis* died within the observation period of three months.

Inoculations of plants in their natural habitat

All trees growing in their natural habitat and inoculated with *P. cinnamomi* developed typical browning around the point of inoculation (Fig. 7). This was usually followed by rapid wilting of the tree. The younger trees died within ten days of inoculation, while older trees survived for longer periods. After 12–15 weeks only the oldest tree, which died two months later, remained alive.

Inoculation of silver trees with *B. ribis* was also successful, although limited lesion development began only 12–15 weeks after inoculation. No trees died within this period.

Both the *Leucospermum cordifolium* and *L. glabrum* plants died within ten weeks of inoculation with *P. cinnamomi*, the symptoms being typical of those on naturally-infected plants.

Re-isolation

Both *P. cinnamomi* and *B. ribis* were consistently re-isolated from lesions developing after inoculation with the respective organism.

Occurrence of *P. cinnamomi* on *Proteaceae*

Phytophthora cinnamomi was isolated from the crown and root tissues of recently-killed plants of the following species growing in their natural habitat or under cultivation.

Leucadendron argenteum

L. tinctum

L. salicifolium

Leucospermum cordifolium

L. reflexum

L. lineare

L. catherinae

Preliminary investigations indicate that certain *Proteas* pp., (eg *P. cynaroides*), are tolerant to this disease.

DISCUSSION

Phytophthora cinnamomi has an extremely wide host range which includes many Proteaceae (Zentmeyer & Thorn, 1967; Robertson, 1969; Weste & Taylor, 1971; Davison, 1972; Podger, 1972; Newhook & Podger, 1972). The present investigation has shown that it also causes a sudden dieback of silver trees, and that the dieback occurs at high temperatures. The effect of high temperatures in enhancing disease development was also noted in Australia where *P. cinnamomi* is particularly destructive to local Proteaceae during the spring and summer months (Newhook & Podger, 1972). It is therefore postulated that *P. cinnamomi* is the pathogen responsible for the common dieback of silver trees and certain other Proteaceae in South Africa.

Botryosphaeria ribis, although a major pathogen, is not regarded as a primary cause of dieback of silver trees.

Although the full host range of *P. cinnamomi* among South African Proteaceae has not been determined, it appears that certain *Protea* spp., notably *P. cynaroides*, are tolerant to the disease. The nature of this resistance is at present under investigation.

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